

**On the coupled simulation of mud motors**  
**IACM 19th International Conference on Finite Elements in Flow Problems**  
**FEF 2017**

**R. Rossi\*, R. Zorrilla, V. Mataix, MA. Celigueta, E. Oñate**

\* International Center for Numerical Methods in Engineering (CIMNE)  
and Universidad Politécnica de Cataluña  
Campus Norte UPC, 08034 Barcelona, Spain  
e-mail: congreso@cimne.upc.edu, web page: <http://www.cimne.com>

**ABSTRACT**

The petrol Industry relies on the use of “mud motors” for the generation of the torque needed by the drill bit . Mud motors are essential inverse pumps in which a rotor is set into motion by the passage of a high pressure fluid.

The simulation of such devices presents major challenges, since it requires taking into account the details of the contact between the rotor and the stator as well as considering the wetting and drying of large portions of the fluid domain, which “open” or “close” to the fluid flow due to the motion of the rotor with respect to the stator.

Curent work focuses on the simulation aspects, detailing in particular the FSI-related aspects. A description of the contact technique employed will also be provided together with details on the MPI implementation employed in the project [1],[2].

We remark in particular that an Immersed fluid solver is employed in following the motion of the rotor, thus making the FSI problem different from both classic FSI approaches [4] and of porous FSI problems [6]. Adaptive remeshing is used adopting the algorithm in [4]

**REFERENCES**

- [1] Dadvand P, Rossi R, Oñate E (2010) An object-oriented environment for developing finite element codes for multi-disciplinary applications. *Arch Comput Methods Eng* 17:253–297
- [2] P. Dadvand, R. Rossi, M. Gil, X. Martorell, J. Cotela, E. Juanpere, S.R. Idelsohn, E. Oñate, Migration of a generic multi-physics framework to HPC environments, *Computers & Fluids*, Volume 80, 10 July 2013, Pages 301-309, ISSN 0045-7930, <http://dx.doi.org/10.1016/j.compfluid.2012.02.004> .
- [3] Baumgärtner, D.; Wolf, J.; Rossi, R.; Wüchner, R.; Dadvand, P., Contribution to the Fluid-Structure Interaction, Analysis of Ultra-Lightweight Structures using an Embedded Approach. Volume CIMNE, Monograph M152. International Center for Numerical Methods in Engineering, 2015
- [4] R. Rossi, J. Cotela, N.M. Lafontaine, P. Dadvand, S.R. Idelsohn, Parallel adaptive mesh refinement for incompressible flow problems, *Computers & Fluids*, Volume 80, 10 July 2013, Pages 342-355, ISSN 0045-7930, <http://dx.doi.org/10.1016/j.compfluid.2012.01.023>.
- [5] Rossi, R., Oñate, Analysis of some partitioned algorithms for fluid-structure interaction *E. Engineering Computations* 2010 27:1 , 20-56
- [6] Larese, A., Rossi, R., Oñate, E., Toledo, M., Morán, R., and Campos, H. (2014). "Numerical and Experimental Study of Overtopping and Failure of Rockfill Dams." *Int. J. Geomech.*, 10.1061/(ASCE)GM.1943-5622.0000345, 04014060.